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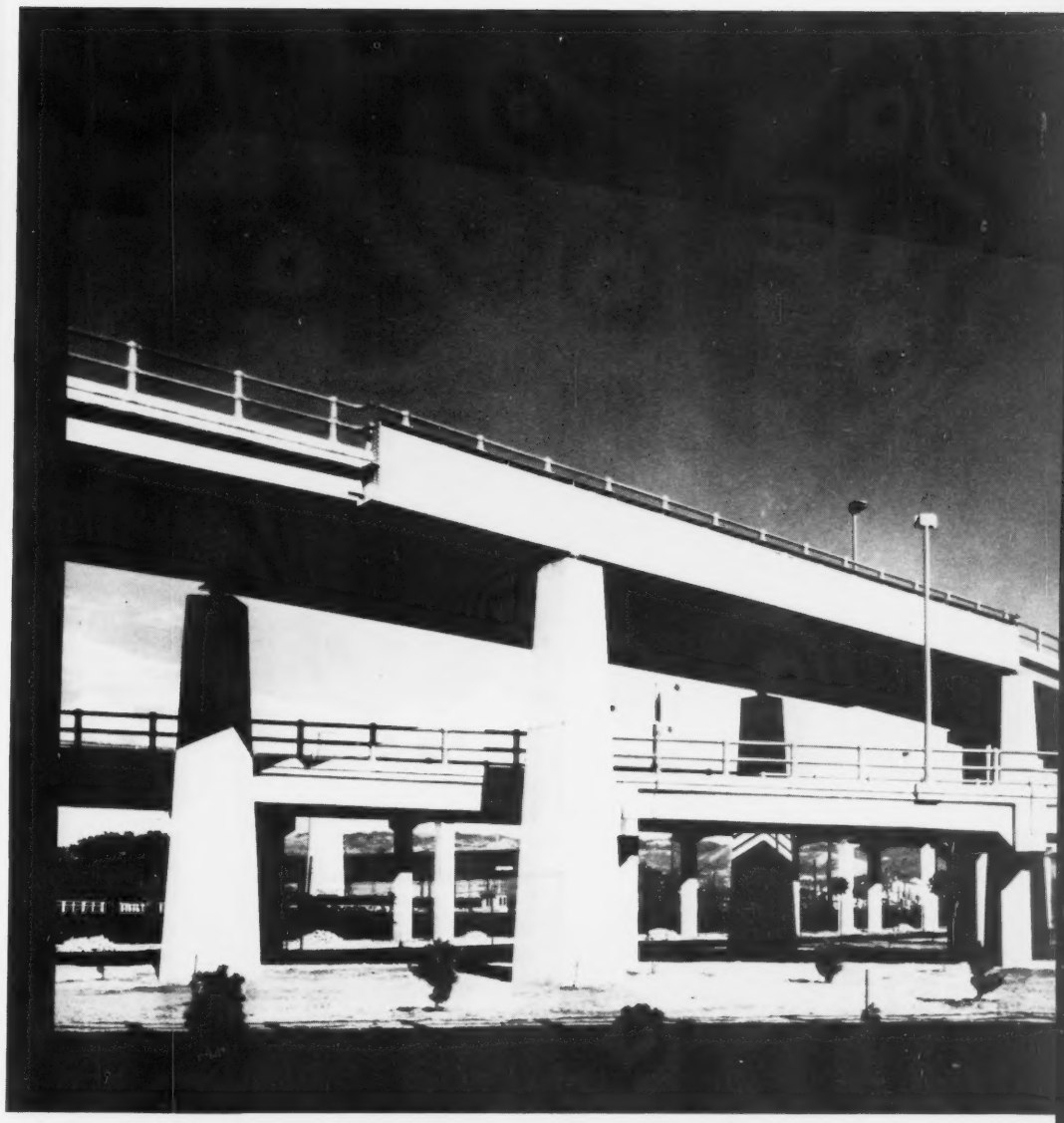
TECH ENGINEERING NEWS



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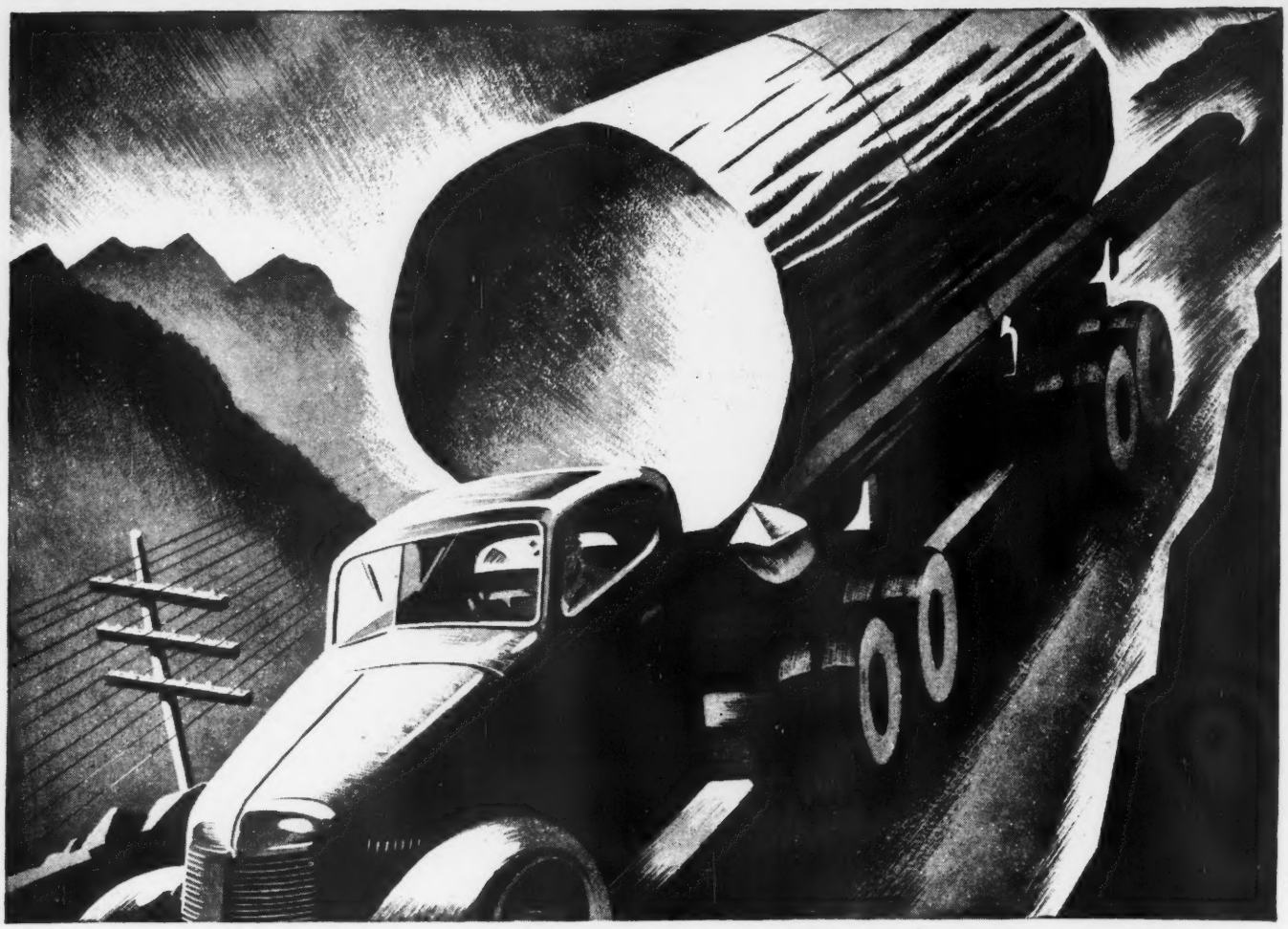

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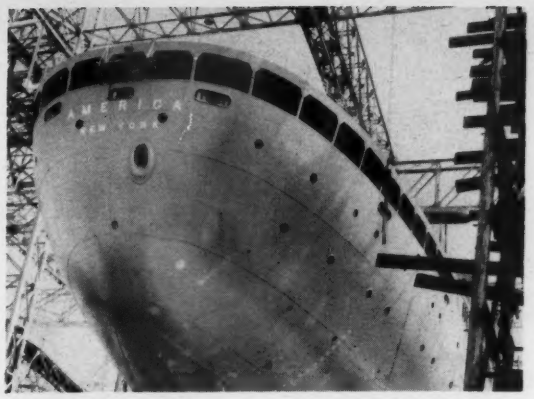

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OUR COVER THIS MONTH. This picture of the Oakland approaches to the San Francisco-Oakland Bridge in California illustrates one of the latest designs in express highways.

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Homeward Bound

BY AIR AND RAIL

THE DISPATCHER

NERVE CENTER OF THE AIRLINE

By CAPTAIN E. V. RICKENBACKER

PRESIDENT AND GENERAL MANAGER, EASTERN AIR LINES, INC.

SERVING as a clearing house for information widely varied in nature, the dispatcher of today's airlines must comply with many demands: he must answer the frivolous questions of the unthinking, and he has the serious business, as well, of deciding whether a trip should be started, cancelled, completed, or held over. He is able to perform with versatility because he has been trained not only to dispense information but also to assemble and analyze information as well.

The dispatcher is a conservative in his dealing with the public, with flying personnel and with other types of personnel. He watches constantly the flight conditions that concern craft over which he has charge. He studies the trends of conditions and observes their influence over the future.

It is required that data on flight conditions used for

the actual dispatch of the flights in question be not more than one hour old. Trends of weather and possible flight conditions are not ascertained from a single report, but from many sources. Although it is not essential for the dispatcher to be a meteorologist, per se, he must be capable of understanding and interpreting the general conditions as given him by a meteorologist. He must be able to discover the trends of flight conditions from the numerous reports that are available to him.

Safety of flight is the dispatcher's primary concern. Passenger comfort and convenience come next in order with speed and revenue as a third consideration. Flight conditions are, of course, closely interlocked with safety. The accuracy with which weather reports are studied is highly important. Weather maps are drawn four times daily both by the weather men of the Civil Aeronautics Authority and by the meteorologists of the airline. The system in use at present is called the Air Mass Analysis System.

The qualified dispatcher reads these maps, locates and forecasts warm and cold fronts and translates the weather conditions on which he has interpretive reports into *flight conditions*. He must be extremely careful of high winds, icing conditions, line squalls, and be able to recognize immediately the imminence of any fog conditions either of the radiation, advection or stratus types.

The dispatcher discusses flight conditions with the meteorologist long before the passengers leave for the airport and, quite often, before the captains (required to report at the airport one hour before departure time) have even left their beds. The dispatcher questions the meteorologist on points that may need clarification so that when the time comes to discuss an impending trip with the captain he can give a clear version of the picture as he sees it.

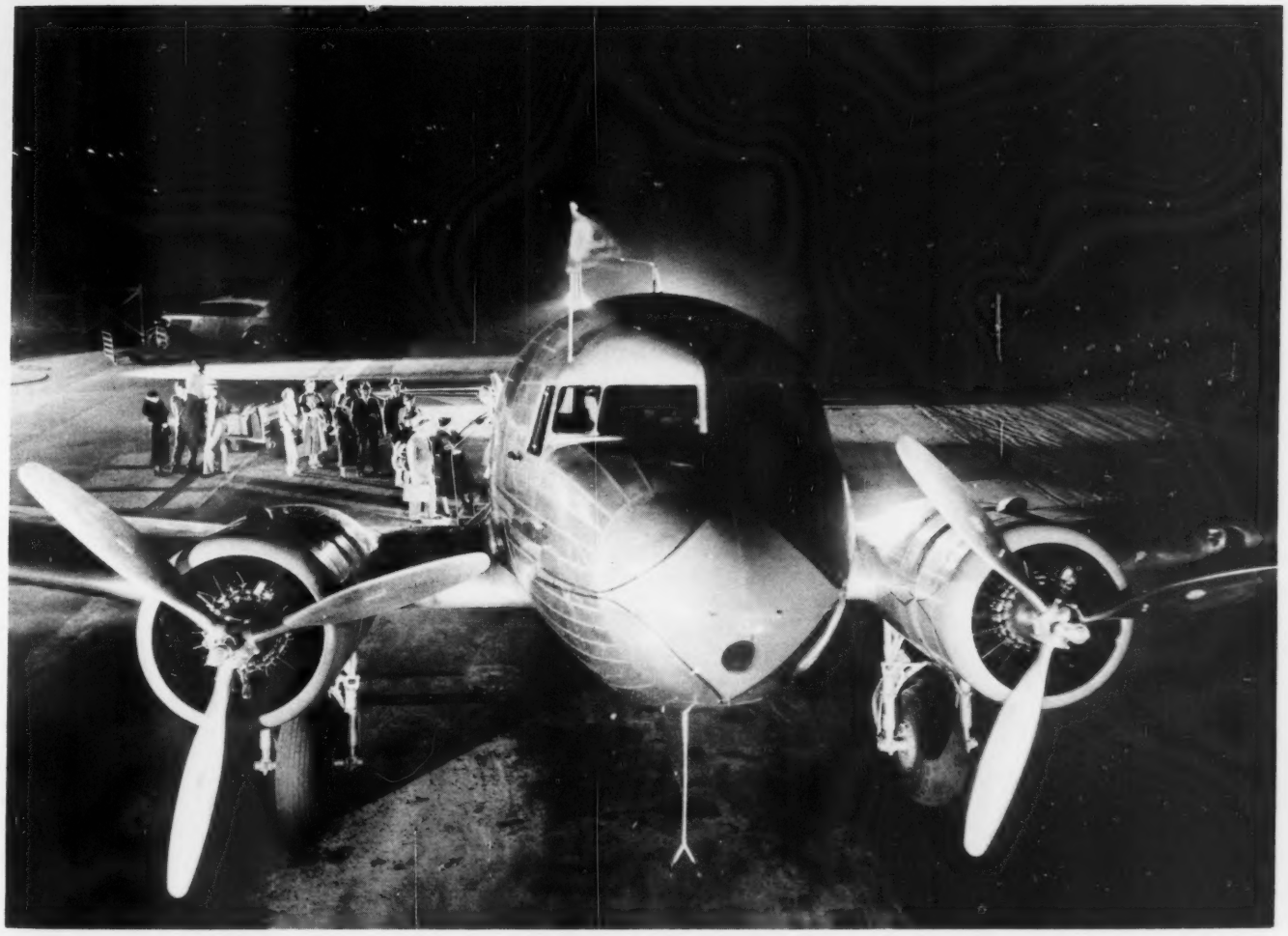
The captain's years of experience will often shed a new light on that picture, bringing the captain and dispatcher to complete agreement. If a captain believes a trip should not fly, then, irrespective of the dispatcher's opinion to the contrary, the flight is cancelled.

A vital source of information for the dispatcher and obtainable only from members of the crew, is a careful analysis of flight conditions encountered on the trip just completed. New situations are constantly arising, hence the dispatcher ascertains just what each member of the crew thinks of the flight conditions just experienced. No two trips are identical. No two sets of weather conditions are identical. No two pilots fly exactly alike even though they were trained by the same method for some years.

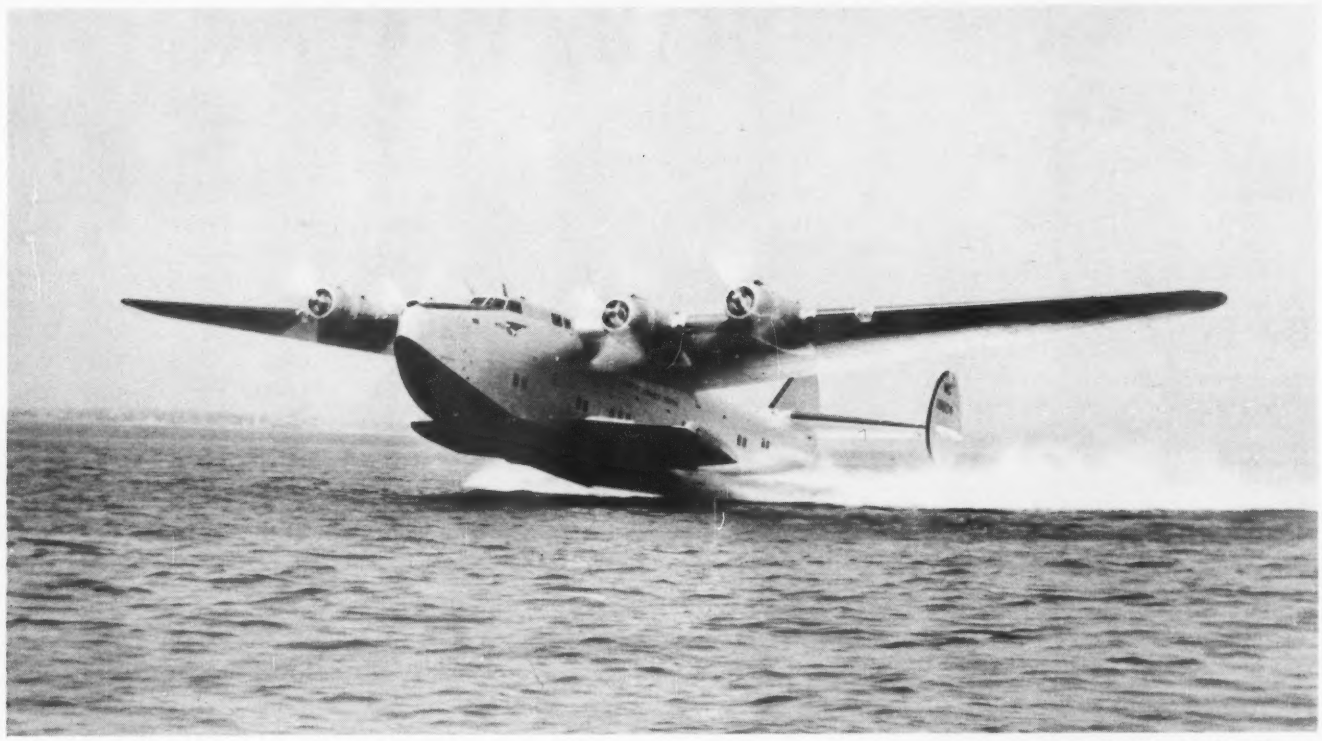
Plane routing is a considerable job requiring close attention and co-operation on the part of the dispatcher with master plane router. In the case of Eastern Air Lines, the master plane router is stationed at maintenance headquarters, Miami, Florida. It is the master plane router's duty to see that the planes and engines are inspected, overhauled, and checked at the proper intervals.

Extra-section flights call, of course, for extra equipment. Reserve captains and pilots are maintained to fly these sections.

Every dispatcher consults, daily, regular charts which list the number of hours flown by flight personnel. The crews — captains, pilots, and flight-stewards — are directly under the control of the dispatcher subject



Courtesy American Airlines



Courtesy Pan American Airways

to the approval of the chief dispatcher and the operations manager. The crews are routed on various trips in such a manner that they do not attain more than the limit of flying time set by the Civil Aeronautics Authority for any one day, week, month, or year. Reserve personnel is available in case of need.

The dispatcher's relation to the traffic department is one of his most important functions. Planes are set for certain schedules. Sometimes it becomes necessary for equipment to be substituted involving a different number of seats. Then the dispatcher must notify all traffic offices of the change and add to or block off the number of seats for sale.

Delays resulting from sub-standard flight conditions are difficult for the average passenger to understand. Frequently the passenger-to-be arrives at an airport where there is very clear weather. Flight conditions may be perfect there, whereas at his destination the conditions may not be flyable. It is the business of the dispatcher to explain these delays to the traffic men in such a manner that when reasons for the delays are explained to the passenger, the latter will understand that analyzing flight conditions is not a cut-and-dried procedure, but is subject to quick changes that may affect the best of well-calculated plans.

The dispatcher notifies the traffic department as far in advance as possible when there is any question whether a trip will be delayed or cancelled. His information supplements, and is more final than the forecasts for trip completion, cancellation, or delay issued at six-hourly periods by the meteorological department.

If such changes are to be made, it is the dispatcher's responsibility to make them and advise the traffic men at least one hour before schedule-departure time. An opinion on flight conditions over the whole route in question must be stated and *shared* with the traffic men. Particular attention must be paid to forecasts for terminals and any intermediate point to which passengers are enplaning or deplaning. Thus it will be seen that in many ways the dispatcher's office and the traffic department are closely interlocked. They must be in constant and *continuous* communication.

Another duty and a very important one that belongs to the dispatcher concerns the plane's load. With present types of planes the amount of load, consisting of passengers, mail, and express, must vary with the

(*Continued on page 153*)

Airport attendant releasing free balloon which measures winds aloft *Courtesy TWA*

RAIL TRAFFIC

RAILROADS ANTICIPATE THE HOLIDAY RUSH

By ROBERT S. HENRY

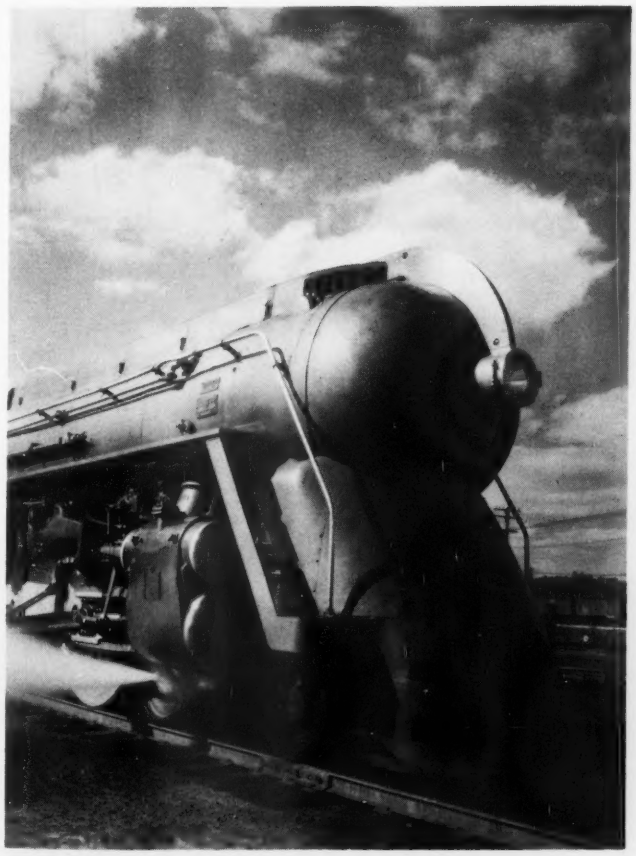
ASSISTANT TO PRESIDENT
ASSOCIATION OF AMERICAN RAILROADS

THIS is the time of year when Tech students, in common with thousands of other undergraduates throughout the country, are thinking of going home for the Christmas vacation. The railroads have already made plans for these students to make the trip swiftly and safely.

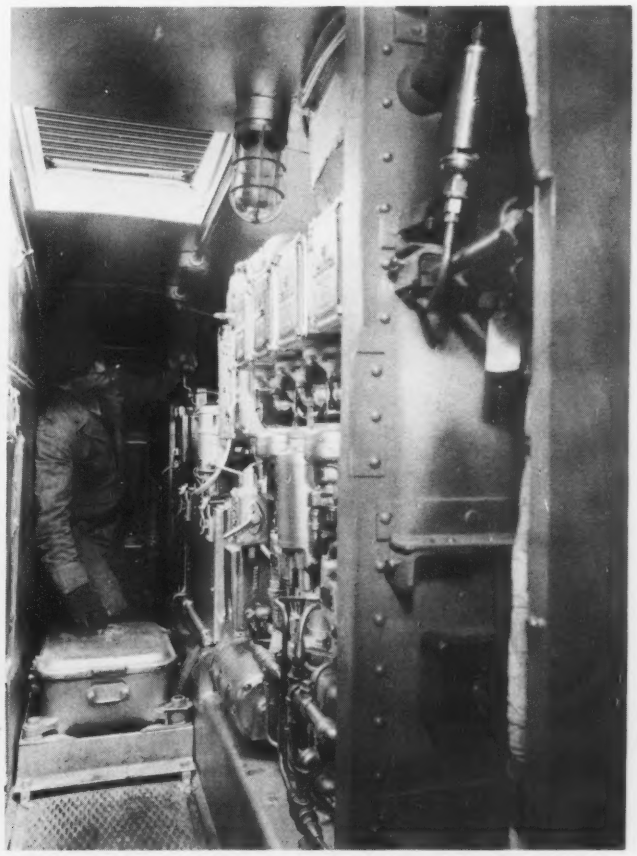
Preparations for handling holiday travel by rail, which is usually from 35 to 50 per cent greater than the normal volume of traffic, start weeks before Christmas. Each large railroad calls a meeting of its chief passenger traffic and operating men and a representative of the Pullman Company. The primary purpose of this conference is to determine, as accurately as possible, how much passenger traffic is anticipated during the holiday season, on what days and at what hours it will be heaviest, and at what points it will be concentrated. Arrangements to take care of the increased business are then made.

The estimates, submitted by passenger traffic representatives at key cities, are based on several factors. Among these are such things as rail travel during the corresponding period of the previous year, the current trend, general economic conditions, the day of the week on which Christmas and New Year's fall, and local situations.

After it has been decided what the traffic will probably be, steps are taken by the operating department to insure adequate handling of the millions of additional passengers. Provision is made for extra sections of regularly scheduled trains and the operation of special trains, such as those for school movements. All extra equipment which will be necessary to meet the expected demand and situations which might arise is called in and placed at those points where it will be needed most. More men are employed at busy terminals and on the trains.



Courtesy New York Central System



Courtesy General Electric Publicity Department

Terminals in large cities which serve more than one railroad also make special preparations. Well in advance of the holidays, there is a meeting of representatives of the terminal company, the rail lines involved, and the Pullman Company. At this time, announcement is made of the special regulations which will be in effect at the terminal during the heavy passenger movement. These regulations are designed to speed up activity by preventing congestion and delay.

As soon as the rush period begins, railroad passenger representatives keep a watchful eye on the traffic and are in constant touch with the operating department. Special attention is given to the complete utilization of regular equipment. Cars are added and removed from trains as conditions warrant, and extra sections are set up and run on short notice. This flexibility of service gives railroads an advantage in handling peak traffic.

Occasionally, traffic at a certain point exceeds all expectations and is so heavy that the railroad serving that particular territory does not have sufficient available equipment there to cope with the situation. When this occurs, equipment is obtained from another railroad. This is a good example of the co-operative spirit that prevails in the whole railroad industry.

During the last two weeks of December, there is a great increase in the amount of mail and express which goes by rail. This, of course, has a natural tendency to slow up passenger schedules. That this may be avoided as much as possible, the railroads frequently operate special trains consisting of nothing but mail and express.

Large passenger movements, then, present no so-called traffic problems for the railroads. The efficient handling of such movements is simply a matter of preparation, co-ordination, and alertness. The railroads are, and will continue to be, ready to meet the nation's transportation needs.

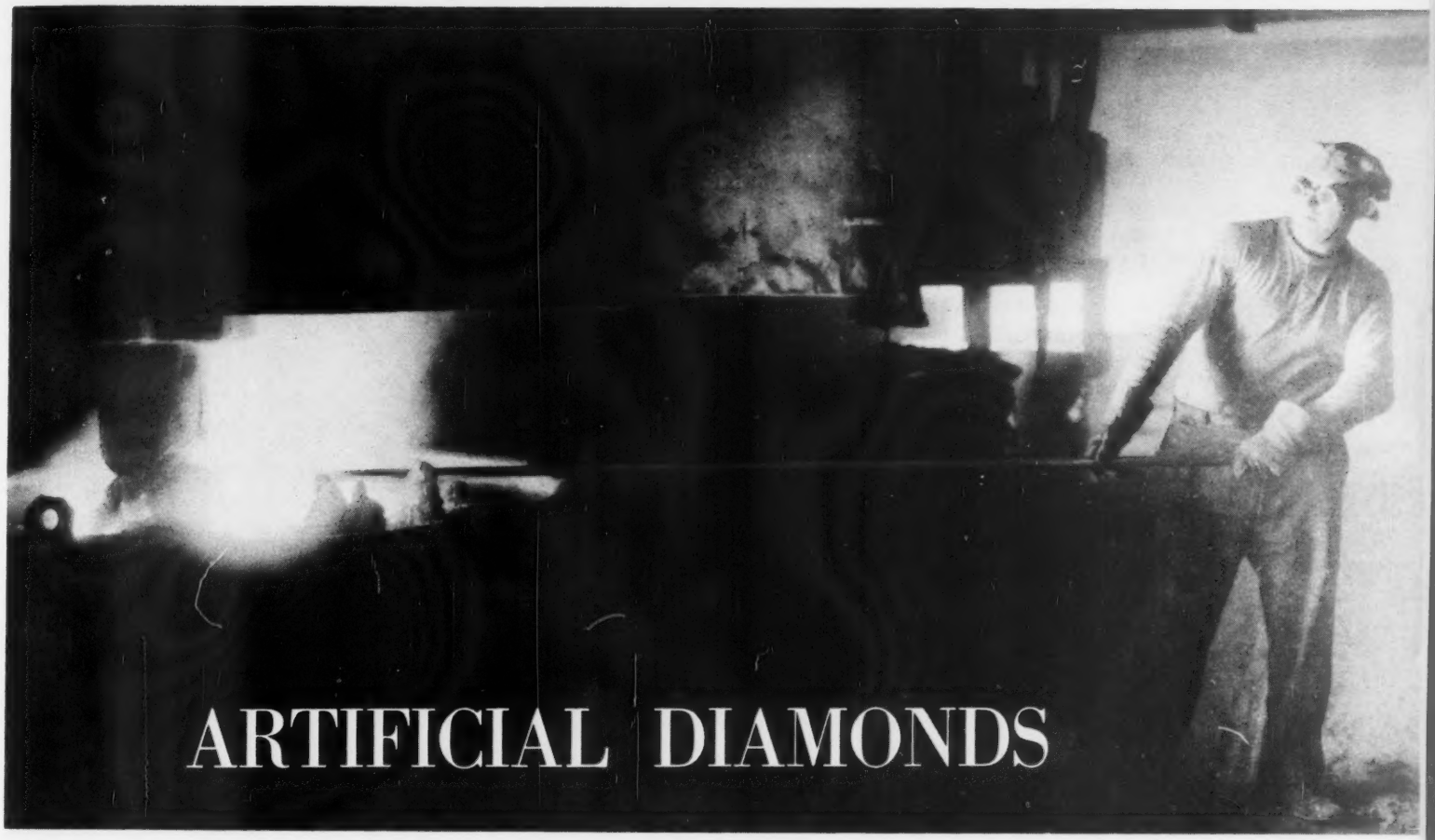
Few people realize the tremendous transportation job being done by the American railroads every day, in all seasons, and in all kinds of weather. In a year, the railroads, besides transporting more than a billion tons of freight, carry approximately 500 million passengers — equal to the combined populations of North and South America, the United Kingdom, France, Italy, Poland, Spain, and Germany.

America operates about 16,000 passenger trains, and somewhere in the land a train is either starting or ending a trip every five seconds. In spite of the fact that a large number of these trains operate over long distances, only rarely does one fail to maintain its schedule.

As most people know, railroad passenger service is much faster now than it was a few years ago. For instance, one can travel from New York City to Los Angeles — a distance of a little more than 3,000 miles — in 24 hours less time than the fastest train several years ago. Today, there are 924 runs scheduled at an average speed of 60 miles or more per hour. The mileage over which these trains operate totals 56,311 miles — more than half of the world's entire mile-a-minute mileage — and their daily mile-a-minute mileage averages 50,000. Sixty-six runs, aggregating 5,899 miles, are scheduled at 70 miles or more an hour. Some passenger trains attain maximum speeds of 100 miles or more an hour.

Increased speed on the railroads, however, has not been accomplished at the expense of safety. In conjunction with the manufacturers of railway equipment, the railroads are carrying on ceaseless research in laboratory and shop, and on the track, always striving to produce better and safer service at less cost. The actual number of train accidents last year was two-thirds less than in 1929.

Courtesy New York Central



ARTIFICIAL DIAMONDS

THE ABRASIVE WHICH FURTHERED MASS PRODUCTION

By RALPH F. GOW

SUPERINTENDENT, ABRASIVE DIVISION, NORTON COMPANY

ALTHOUGH the abrasive industry probably had its beginning hundreds of years ago when the cave man's first tools of bronze and iron were sharpened by rubbing against certain stones of the field, the industry as we know it began in the latter half of the nineteenth century. Prior to this time, grinding was performed by natural sandstones, *i.e.*, pieces of sandstone fashioned into the shape of a wheel. Although these met the grinding requirements of those times, the mechanical arts were progressing rapidly and it soon became apparent that the variability and limitations of sandstone as it occurred in nature were definite handicaps to our industrial progress.

Then in 1864 came the invention of the emery wheel — grains of emery, a natural abrasive, bonded artificially into grinding wheels. Although this was but a crude forerunner of the present scientifically controlled grinding wheel, it established a milestone in the progress of the abrasive industry. For the first time abrasive particles were taken and artificially bonded into a grinding wheel. This allowed the abrasive engineers to exert a control over the bonding of these abrasives, but the variations in the abrasives themselves were still dependent upon nature. Emery had been known for four or five thousand years, but had always been used previously in the form of a powder or grain. As found in nature, emery is a rather impure abrasive consisting of a number of components. Its ability to grind or cut comes chiefly from the corundum it contains. Corundum, which also occurs relatively pure, is natural aluminum oxide and is a constituent of emery, varying from 37 to 70 per cent in natural deposits. Obviously, the grinding wheels made with emery might vary greatly in their cutting characteristics, if corresponding variations are made in their composition.

Above is an arc type electric furnace in which bauxite is fused into alundum (aluminum oxide) abrasive in the Norton electric furnace plant.

There was a need for an artificial abrasive which could be produced more uniform in purity and hardness than any found in nature at a cost which would permit grinding wheels to take their place as a production tool in the metal industries. In 1893, Edward G. Acheson was trying to produce artificial diamonds by subjecting a mixture of carbon and clay to very high temperatures. The result was some black, shiny crystals of extreme hardness. Although he had failed in his attempt to pro-

duce artificial diamonds, he had discovered an artificial abrasive — silicon carbide — now made under several trade names as Crystolon, Carborundum, etc. At first this was so expensive — $880 a pound — that it was used only for cutting and polishing precious stones. The importance of this discovery was immediately recognized by abrasive engineers and efforts were made to produce silicon carbide at a commercial cost. Today this abrasive sells at about fifteen cents a pound. It is used in large quantities in the manufacture of grinding wheels as well as being sold as loose grain for polishing and other purposes.

About the same time Charles B. Jacobs developed a commercial method of producing artificial aluminum oxide — artificial corundum. In its manufacture, natural bauxite is subjected to the terrific heat of an electric arc furnace. This heat converts the bauxite to a hard abrasive consisting principally (95 per cent) of aluminum oxide. By this method the abrasive can be produced at commercial figures.

With these two artificial abrasives it then became possible for the industry to get its real start and to take its place as one of the major tools of the mass production industry. It is safe to say that without the grinding wheel and other abrasive tools our present mass production methods would be impossible. Were it not for modern grinding the automobile of today would be so costly that only a few could buy it. Modern printing presses and other high-speed machinery require the accurately ground parts for their successful operation.

Blocks of granite are easily cut by huge abrasive wheels

Alloy steel manufacture consumes a great deal of the output of the abrasive industry, and, in fact, there is scarcely an hour of the day when we do not come in contact with some article made possible at its present price by the abrasive industry.

Under present day methods large quantities of electric power are required in the production of both types of abrasive. For that reason the plants are generally located near a source of abundant, cheap power. At the ore plant the silicon carbide is produced by making a mixture of carefully selected pure sand, sawdust, and coke. This mixture is placed in a furnace between two electrodes — the mixture forming, in effect. a resistance. The heat generated in this way reaches the 2200°C. or more required to convert the mixture to the desired silicon carbide (Figure 1). After peeling off and discarding the unconverted outside surface of the mass, the remainder is broken up by hand into conveniently sized lumps and is ready for the crushing mill.

The aluminum oxide abrasive is produced in a somewhat different manner. The crude bauxite is first calcined to drive off water. It is then mixed in an electric arc furnace with iron filings and coke which serve to carry off certain impurities. Electric power is then applied to the electrodes of the furnace and the mass is gradually heated until it is completely molten at a temperature of around 1950°C. (Figure 2). It is then allowed to cool until it solidifies and, while still red hot, is removed from the furnace as a large lump, commonly referred to as a pig. The pig, when completely cool, is broken down by sledge hammers to a proper handling size.

Successive processing of both abrasives is similar. The lumps as they come from the ore plant pass through jaw crushers and manganese steel reducing rolls, which crush the abrasive lumps until the largest particle is about an eighth of an inch across. This abrasive grain is next washed to remove grease and dust which may have accumulated in transportation or crushing. This is necessary so that when it is bonded into wheel form or glued to abrasive paper the grain will have a clean surface which gives maximum holding strength. Next, high intensity magnetic separators remove a large part of the iron which would cause difficulty when grinding wheels are made at high temperatures. The abrasive grain is now ready for the final operation of screening to the finished sizes. As it leaves the mill each batch of finished abrasive grain must be inspected for size, freedom from dirt and dust, for magnetic iron content, etc. A batch of grain falling short of requirements in any one of several particulars must be returned to the mill for reprocessing.

Abrasives are used in many forms. For polishing, grain is glued on canvas wheels. Abrasive cloth or paper, sometimes referred to as emery cloth, is made by gluing abrasive on tough cloth or paper. Certain high temperature refractories are made by bonding together abrasive grain. Non-slip, wear-resistant floor treads contain abrasive. However, the largest use of abrasives is in the grinding wheel.

Grinding wheels are made by bonding together abrasive grains in the form of a disc, or wheel. When revolved at a high rate of speed and held against the work to be ground, each grain becomes a sharp, hard, cutting tool capable of removing a small chip of metal. Since the average grinding wheel revolves at a peripheral speed of 5,000 s.f.p.m., each grain makes several cuts per minute. The wheel must be so designed that the grains dulled by this constant usage are discarded or torn from the wheel at exactly the instant when they become inefficient. This necessitates careful control of the character of the bonding. Since the quality of finish imparted to the work depends on the size of the chips, one large or coarse particle of abrasive in a wheel might ruin an expensive piece of work. Furthermore, these wheels, often as large as four or five feet in diameter and weighing a thousand pounds or more, travel at a peripheral speed of a mile a minute. A slight out-of-balance condition will set up excessive vibration. But more important, every precaution must be taken to prevent a flaw which in case of a breakage in use, might send several hundred pounds of grinding wheel flying through the air. For these reasons and many others, the manufacturer of grinding wheels is enlisting the highest degree of scientific control in all steps of the process.

(*Continued on page 149*)

NO MORE STATIC

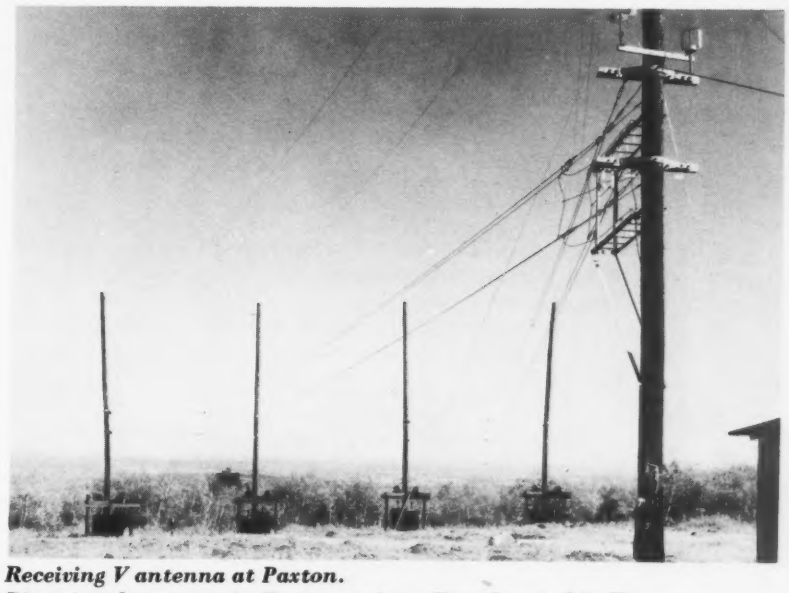
RADIO RECEPTION MAY SOON BE IMPROVED BY FREQUENCY MODULATION

By D. M. POWERS, '43

THE most outstanding recent development in the field of radio is the new system of frequency modulation. It is of interest to everyone because it may completely supplant the present system of broadcasting. Although new in the sense that it has just begun to receive attention, work has been going on quietly for six years. Frequency modulation broadcasting is rapidly leaving the experimental stage, and has progressed far enough already so that its results are commanding wide attention from radio engineers. The inventor of frequency modulation, the man who carried it to its present state of practicability, is Major Edwin H. Armstrong. Those interested in radio will remember that Major Armstrong is also the inventor of the regenerative, superheterodyne, and super-regenerative circuits which have made radio, as we know it today, possible. He published the first description of his system of frequency modulation in May, 1936. Since then, the improvement in apparatus has reached the point where commercial broadcasting is feasible.

Simply, this development operates on the principle of securing modulation by varying the frequency of the emitted signal. Standard broadcast stations universally employ amplitude modulation, or modulation by varying the carrier output on a fixed frequency. Frequency modulation reverses this, that is, the carrier strength remains constant and the frequency is varied by audio waves to produce a modulated signal. The theory underlying the principles involved is much more complicated than the brief description indicates. The result of changing the frequency is to require a band whose width approaches 100 kilocycles. As the radio spectrum up to 30 megacycles is much too crowded for a 100 kilocycle transmitter, the frequency modulation (FM) stations have been assigned bands in the ultra-high-frequency part of the spectrum. At the frequencies used, it has been found that excellent signals are possible for a radius of from 50 to 100 miles. Also, when two transmitters are on the same channel, the louder one will predominate nearly 100 per cent at the receiving point. These facts will prove to be of great value if a large number of stations go into operation, because the same frequency can be used without interference, by stations separated by approximately 200 miles.

Certain important advantages accrue from the use of frequency modulation, that make it superior to amplitude modulation. The major improvement is that static, ignition noises, motor noises, and other disturbances whose character is of varying amplitude are discriminated against, since the receiver and transmitter are designed to be sensitive only to frequency changes. Reception, therefore, is essentially noise-free. For this reason, frequency modulation has been sometimes referred to as "static-less radio." The second big advantage is the fidelity realized with the new type of transmission. The realism is truly remarkable when compared to previous conceptions of high fidelity in regular broadcasting. Falling water, organ music, piano music, and other sounds are so natural that one is led to believe that they come directly from their source, and not by way of a transmitter and receiver. Another substantial advantage which frequency modulation holds is its greater efficiency. Hence, for the same results, an FM station needs less power and is less costly.



Receiving V antenna at Paxton.
Directional antenna in Boston points directly to this V.

The disadvantage, if it may be called that, of requiring a wide band of frequencies is greatly nullified through the use of bands in the broad expanses of the ultra-high-frequencies. It has already been shown how interference may be eliminated.

Besides W2XMN, Major Armstrong's own station at Alpine, N. J., there are several other FM stations in existence. By far the most advanced set-up is owned by the Yankee Network in New England. Their station, W1XOJ, went into regular service on July 24, 1939, with a 16-hour schedule that has set a record for continuous operation at the ultra-high-frequencies. Programs originate at the Yankee Network Studios in Boston and are relayed by an FM transmitter, using a frequency of 133 megacycles, to the main transmitter

(*Continued on page 153*)

EDITORIALS

PEACE AND THE TECHNICIAN

At the present moment there are groups of thoughtful people all over the world who believe that serious though the present war is, the real crisis is yet to come. That crisis will be the conference at which the war is liquidated. It can be argued, indeed, that the settlement will comprise the most important decisions made in modern history, for by them it may well be that civilization will stand or fall.

In these days we are all apt to be weary of "crises," of the "fall of civilization," of all such gloomy talk. It is too bad that more terms do not exist to substitute for this talk, but, whether or not we like it, or are weary, the gravity of these days and of days to come still remains. All the ennui in the world will not dissipate the peril before us. These are no times for indifference on the part of anyone. It will be increasingly the duty of all to consider the issue facing the intelligence of humanity: What kind of a peace will we have? Public opinion must be prepared for that question — and prepared to give as intelligent an answer as possible.

The principal subsidiary problem to come up will be the nature and extent of some form of world organization. For Americans, the related question logically follows: What will be the nature of American participation, if any, in such an organization? Should we join in an effort at another world-wide plan, or should we be more favorably disposed toward regional groups of co-operating states — in our own case, those of the western hemisphere? Whatever the answers are to these larger issues, the subdivisions of the settlement are going to involve more or less technical problems having their bases in such matters as transportation, communication, raw materials, food production, and fuels. These will be vital problems, for the strongest stone in any successful international structure will be that of a decently functioning world economy.

To the hewing of that stone, the technician can contribute much. Only a few individuals, relatively, will make the final decisions, but they must be guided by the "experts." Some of these experts will have to be men from those fields of investigation whose pursuit is the primary business of institutions like our own. In addition to effecting this *direct* impact of trained knowledge on the settlement, persons educated in these fields have a duty to see their knowledge thrown on the right side *indirectly*, by all the means open to them as ordinary citizens.

Long before the peace settlement is made, however, public opinion must be prepared for it. Great readjustments are going to be made; the ground must be prepared for them. In that preparation, men who are making their life work the wise handling of matter have a job to do. It is to acquaint themselves first, and, if possible, others later, with the international significances of their skills, with the success and failure in terms of international relations which will follow the wise or wicked utilization of their skills.

"Civilization is a race between education and catastrophe." Let the engineer ponder that sentence and then see the duty to which, as a citizen of a country and of a world, he is called by his training!

PROF. THEODORE SMITH.

"WHY ACTIVITIES?"

The question, "Why should I partake in an extra-curricular activity while at M. I. T.?" may not easily be answered in a few words. Yet since so many members of the student body constantly give so much of their time to the promotion of these activities, there must be good and sufficient reasons for doing so. The course of study required by the Institute requires earnest scholastic endeavor on the part of anyone who is to receive a degree. "Why then," many ask, "should I make the grind harder by devoting valuable time to something which will not benefit me academically or financially?"

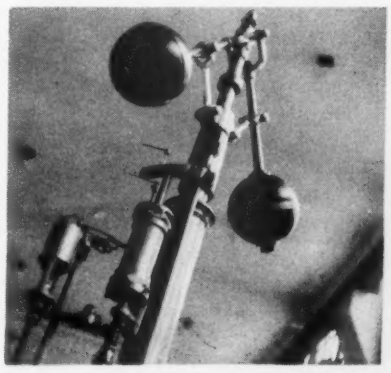
It is true that no tangible assets in the form of better marks or monetary return can be gained from the activities at Tech. At many colleges the various publications are run for profit, and the returns are divided among those students who comprise the staff. A senior engaged in the management of a large college paper, for instance, may make as much as a thousand dollars a year. No publication at the Institute offers this possibility of financial return for services rendered.

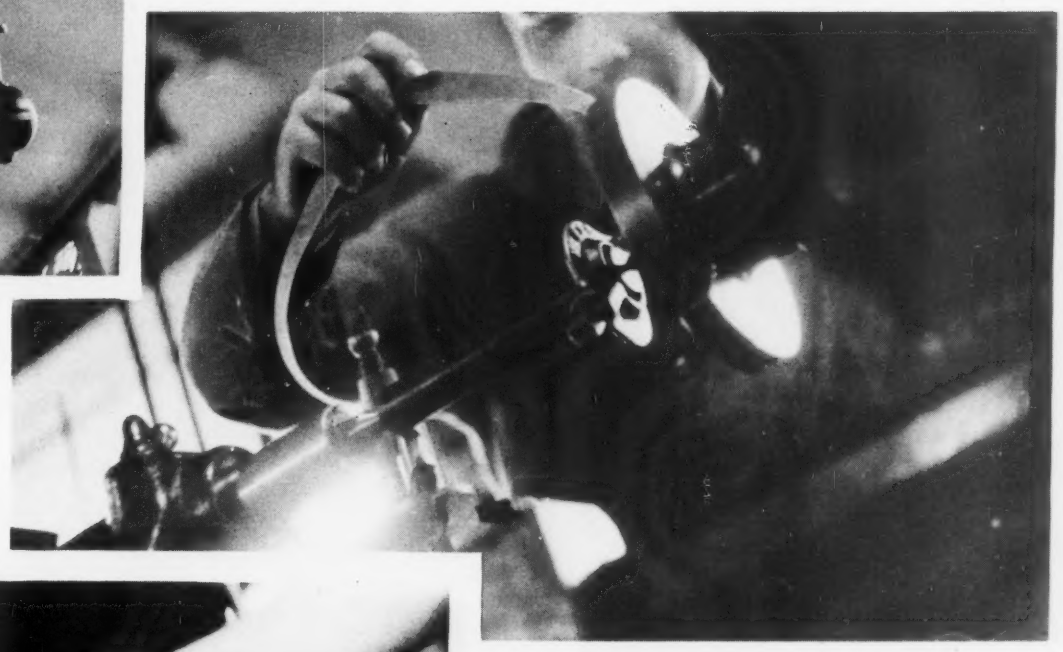
And yet the number of freshmen every year who turn out for activities is continually increasing. They are seeking those intangible benefits which can be acquired only from participation in a student-managed organization. To be of value in the industrial world a student must acquire considerably more than just academic knowledge during his four or five years at a college or university. Companies do not come to the Institute to hire ratings. They come for the purpose of hiring men to do jobs. The technical knowledge needed may be obtained either at school or at the job itself. The insight into personal relations, however, the executive ability, and the experience necessary to perform properly in a real job are best obtained in a student-run activity. Experience gained in working on a publication, for instance, corresponds very closely to the situation which will be encountered by a college graduate in the business world.

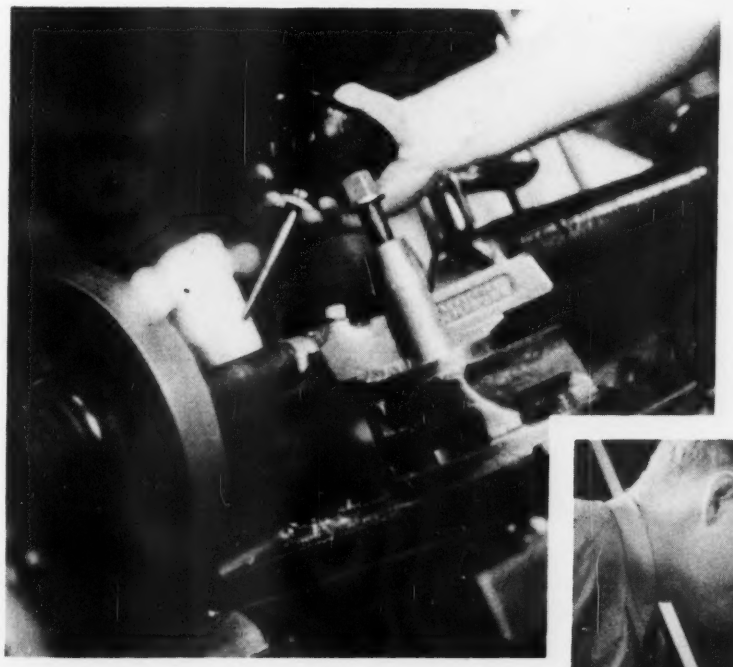
The freshman year, or apprentice stage, is generally devoted to routine office work and to learning the working setup of the organization. Here faithful work and intelligent observation of methods, just as in any industry, will prove the key to success. Duties of a sophomore are less menial, but still remain under the close supervision of a superior. The sophomore, of course, participates in the guidance of freshman work. Juniors, as a rule, become department managers, whose job it is to plan and supervise some particular branch of the

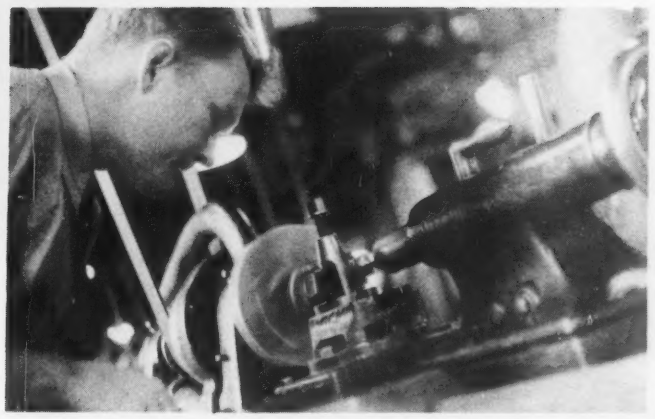
organization. Here is a real opportunity to develop managerial and executive ability. The record of intelligent, efficient direction of a department of a publication is a far better guide to the value of a college graduate in industry than any scholastic rating which he may have obtained. Scholastic intelligence is of little use to a business except in the manner which it may be applied. The senior board is made up of those men who have proven their ability to manage the publication. Theirs is the policy-forming position which must be held responsible for all ups and downs of the organization. In their hands are the real problems of management and co-ordination. Since they represent the supreme authority of the publication, they may be likened to the top executives of a business.

Participation in student activities, then, is an opportunity to obtain actual experience in non-academic work. Since students at the Institute are interested in preparing themselves for industrial conditions, they welcome the opportunity for a rounded school life.









This group of photographs was submitted by Jacques Shaw, '42. They present a new angle of the machine tool laboratory.

AUTOMOBILES AND THEIR PROBLEMS

A MONTHLY PAGE OF THE TECH ENGINEERING NEWS

SAFETY GOES TO COLLEGE

UNIVERSITIES of America have joined a great national crusade — the highway safety movement. Utilizing all their powers of leadership and education, they have undertaken on a rapidly broadening scale the training of traffic engineers, traffic police, and traffic safety teachers. Already several thousand men and women have received some of this specialized higher education.

With so little fanfare that the public scarcely has realized what is being done, universities in various parts of the country have been conducting courses in traffic safety, attracting students from every state in the Union.

Although many colleges have taken part in the movement, three might be termed as headquarters for highway safety education because they are conducting full year courses — Yale for traffic engineering, Northwestern for traffic police, and New York University for school teachers specializing in safety instruction.

Statistics can only faintly suggest progress in the essentially human problem of the behavior of men, women, and children in traffic, but a few figures will give some ideas of what these universities have accomplished.

The Bureau for Street Traffic Research, originally at Harvard, but now located at Yale, has sent into all but ten states seventy-five men trained in the full year traffic engineering course and two hundred others from the short courses.

The Northwestern University Traffic Institute has graduated from its full year course forty-four police officers, who are working in twenty-seven cities and eleven state police departments. In addition, 1,350 policemen have attended the short courses at the University and other colleges under the Traffic Institute's supervision, while 1,800 officers have been trained for service by accident prevention bureaus.

Twenty-eight graduates of the Center for Safety of the New York University have returned to their own schools. Three hundred have taken the short courses and sixty others the summer course at the University. As an additional activity, the college has conducted forty-seven courses at summer sessions in other colleges. From these courses approximately 20,000 teachers have learned the latest method in presenting accident prevention information to school children, the drivers of tomorrow, who are in the foreground of the traffic problem of today.

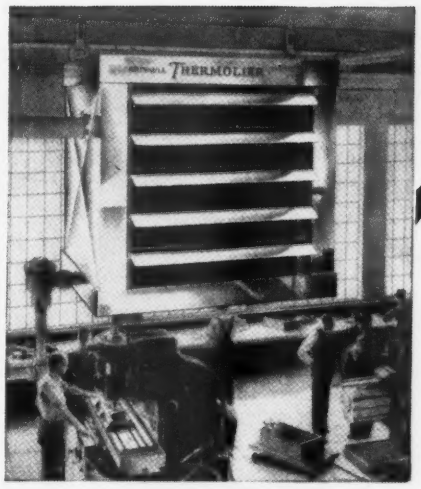
The movement of these trained, or at least better informed, men and women into the traffic situation of the country has had far-reaching consequences.

The college-trained traffic engineer, acquiring knowledge of traffic planning and roadway design developed by years of research, not only applies what he has learned to his own job, but spreads the information among associates. (*Continued on page 148*)

The Kew Gardens Loop, Long Island, as is shown here, is designed to permit an uninterrupted interchange of traffic without grade crossings and left turns at the junction of the Interborough, Grand Central Parkway and Grand Central Parkway Extension.

GRINNELL

WHENEVER PIPING IS INVOLVED



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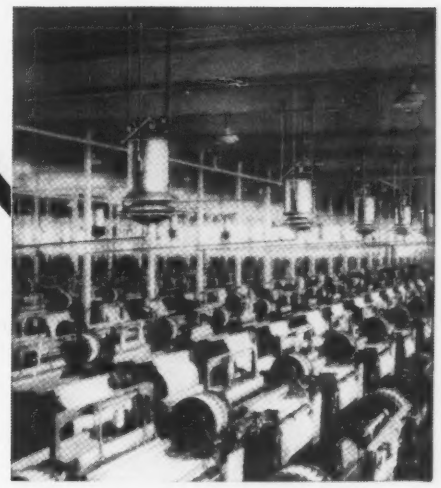

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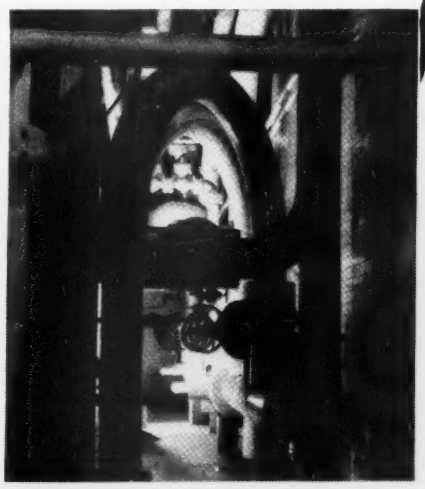

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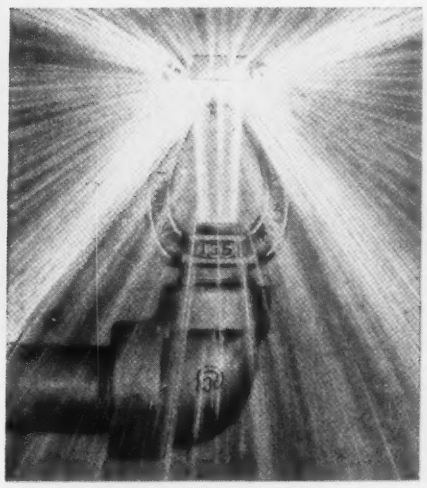

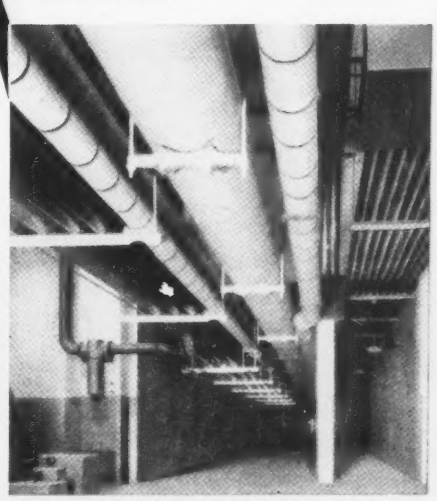

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IT PAYS TO FLY THE WAY OF--
THE GREAT SILVER FLEET

EASTERN Air Lines

EASTERN *Air Lines*

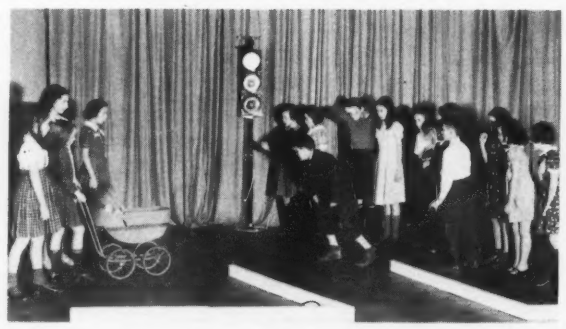
SAFETY GOES TO COLLEGE

(*Continued from page 146*)

The college-trained police officer, who usually holds an executive position or is likely to be advanced to one upon the completion of his course, quickly brings about improvements in local traffic regulations and transmits his knowledge of modern methods to many men in his department.

The college-trained safety teacher, sometimes a principal or supervisor, introduces traffic safety instruction to his entire school system or brings about improvement of methods already in use. In addition to assisting other teachers in modernizing their methods, he makes direct contact with many children of the school age, helping them to learn about automobile operation.

The first college activity in connection with highway traffic was undertaken at Harvard University in 1926 when the late Albert R. Erskine, president of the Studebaker Company, financed the inauguration and early years of the Bureau for Street Traffic Research. A year ago, the bureau and its educational activities were transferred to Yale, where the full year students hold fellowships financed by the Automobile Safety Foundation and Alfred P. Sloane, Jr., chairman of the board of General Motors.



For the 1939–40 academic year, Yale has twenty-two students in the traffic engineering course. The fellowships provide $1,400 for each student for tuition, maintenance, and travel. The bureau aims to develop full-fledged traffic engineers, competent of giving a guiding hand in planning as well as operating traffic control systems. With the idea before them of applying fact and technique rather than opinion and emotion, the students undertake field investigations as well as classroom studies. All are graduates of recognized engineering colleges from all parts of the country. Largely as a result of the work done by the bureau and its students, thirty-five cities have formulated traffic engineering departments and many other cities and states have been assisted in improving their traffic systems.

The American Automobile Association, a pioneer in safety education, is working through a large number of colleges to help high school teachers. Last year the A. A. A. directed teacher training courses in forty-two colleges after giving special instruction at Duke, Michigan, California, and Oklahoma to the faculty members assigned to the courses.

Financial supports appear to be secured, and the indicated expansion of motor vehicle use calls for a corresponding enlargement of intelligent efforts to expedite and safeguard the travels of a nation on wheels.

Condensed from MOTOR

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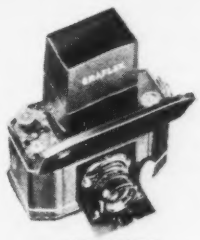
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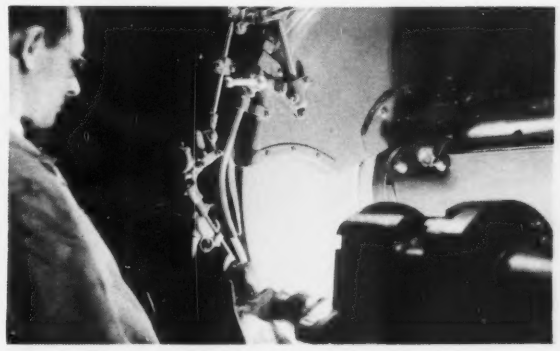
ARTIFICIAL DIAMONDS

(*Continued from page 142*)

Grinding wheels are bonded with a variety of materials — ceramic clays, resinoids, rubber, silicate of soda, shellac, and magnesium oxychloride. Of these by far the most common is ceramic clay. Wheels made with this are called vitrified wheels. It is this type of wheel we will describe here.

The material used to bond these wheels is a mixture of slip clays, ball clays, quartz, feldspar, etc. Each of these is found in nature, and the greatest care is needed in selecting the right pit and even the section of the pit from which to mine them. Each material is dried and finely pulverized. Next follows the preparation of the bond itself. Exactly the right quantity of each clay, feldspar, etc., must be weighed out and mixed together. Each manufacturer has his own particular combination of the clays which gives him what he calls his bonds. He will use a different type of bond depending upon the use to which the wheel is to be put.

The first step in the manufacture of a grinding wheel is the weighing out of quantities of abrasive and bond that will produce a wheel capable of fulfilling to the letter the requirements of the customer. This weighing out must be done very accurately if the finished wheel is to be satisfactory. Next, these two chief ingredients must be carefully mixed in such a way as to get an intimate mixture During the mixing operation a slight amount of water is added which gives the clay a moistness so that the finished mixture has a slight stickiness.



The actual formation of the wheel is done in powerful hydraulic presses which compress the mixture under a pressure of more than one ton per square inch. The wheel mixture, due to the slightly moist clay bond, has enough cohesiveness so that it will hold its shape when removed from the mold of the press. It is then dried. In this condition it is extremely weak and friable — resembling somewhat the characteristics of a "mud-pie." It is now said to be in the "green state."

Although the majority of vitrified grinding wheels are made by pressing, this is a fairly recent development and a sizeable proportion of wheels are still made by the "puddled" process in which abrasive and bond are weighed out as above but the mixing is performed by adding enough water so that the mixture can be poured into molds of roughly the desired shape.

From this point the operations are the same for wheels made by both methods. The next step is to give the wheel its strength and hardness. This is done by vitrifying the bond — that is, for all practical purposes the clay is turned

into a glass by subjecting it to a high heat. The two general classes of kilns in which this is done are periodic kilns and tunnel kilns. In the former the green wheels, supported by refractory pieces, are loaded into circular kilns. The heat is applied through a series of radial fireboxes and the temperature is gradually raised to a point sufficient to melt the clays. After holding the kiln at this temperature long enough to give proper vitrification to the bond the kiln is allowed to cool until the wheels can be removed, strong and hard. In the other class of kiln, the tunnel kiln, the "green" ware is loaded on cars. These cars then pass through a long tunnel which is gradually hotter along its length until the vitrification temperature is reached and then declines again to room temperature. Thus as the cars pass through the tunnel the wheels go through the desired heat cycle.

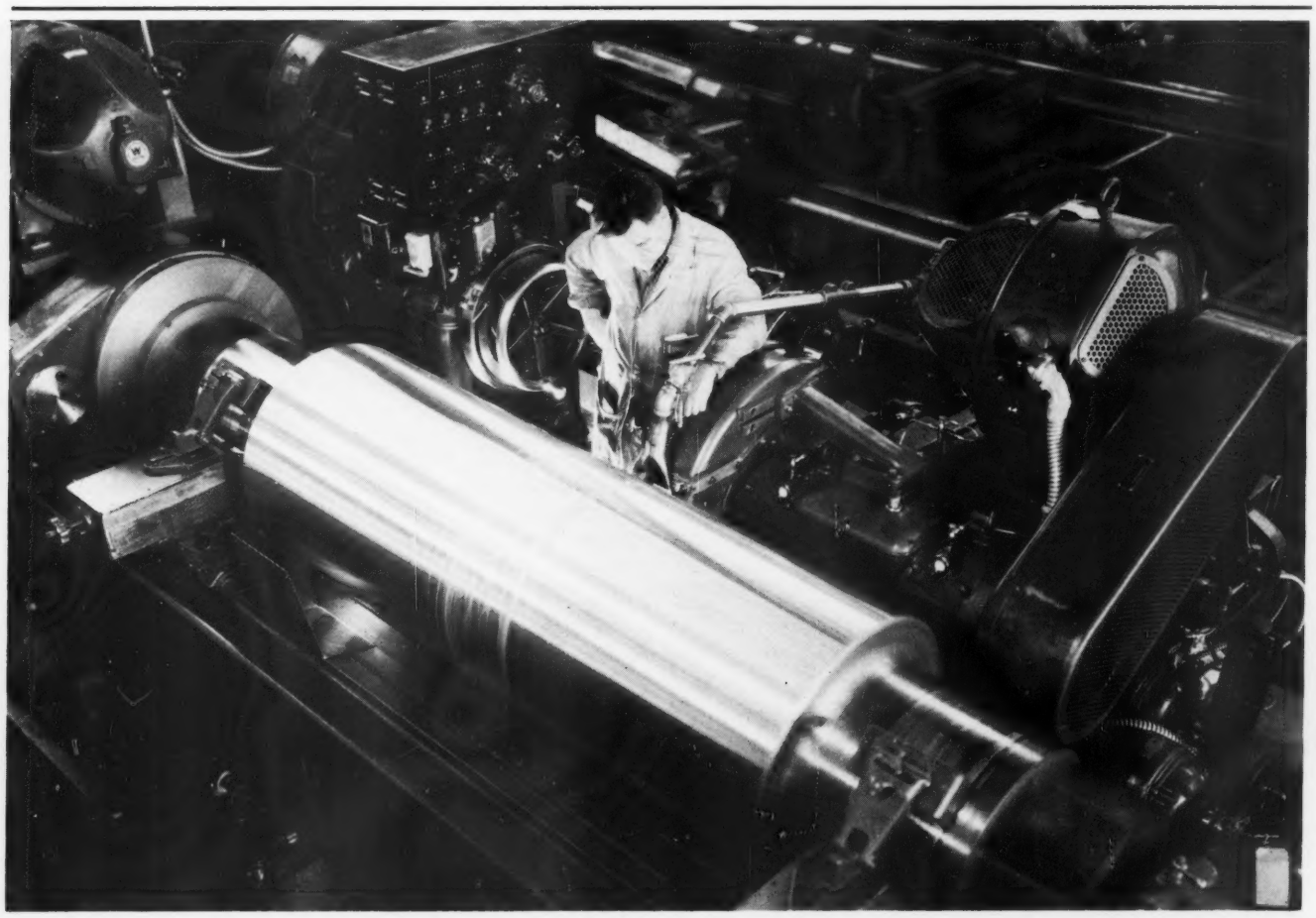
As the wheels come from these kilns they have their finished hardness and strength. The remaining operations do not in any manner affect the grinding action but are the mechanical operations needed to finish the wheel to size and to test the wheel to be sure it will answer the requirements of the customer's order.

The wheel coming from the kiln may not be exactly to size or shape, and it may be necessary to cut the wheel down slightly. This operation, known as truing, is performed in several ways. One common way is by grinding with other wheels; another is by cutting with a diamond; still another is by means of hardened steel cutters revolving on roller bearings which pry off the excess material.

Holes must be accurate in size. Otherwise when the wheel is mounted on the spindle of the grinding machine the periphery, or face, of the wheel will not revolve in truth around the axis of the spindle. Furthermore, holes must be exactly concentric with the face of the wheel. For these reasons great care is required in finishing the holes of grinding wheels, and close size tolerances of a few thousandths of an inch are maintained. By one method the wheel is clamped at the face by a three-point chuck and a babbitt bushing thus poured at the exact center around an arbor of the proper size. By another method the wheel is similarly held and the hole accurately ground on an internal grinding machine.

Since the wheels are to be used to grind very accurate surfaces while revolving at high speeds it is important that they be free from vibrations caused by any out-of-balance condition in the wheel. Although frequently vibrations can be traced to some condition in the machine on which the wheel is used, grinding wheel manufacturers recognize that every precaution must be taken to be sure that each wheel is in good balance. Before shipment, wheels are tested for balance and any wheel found to be more than slightly out-of-balance is rejected. Small out-of-balance conditions may be corrected by counter-balancing with lead inserts.

Because of the exacting requirements under which grinding wheels operate, each wheel is carefully inspected and tested before shipment. First, wheels are tested for hardness or strength of bonding. This test is performed by measuring the strength with which the bonding material holds the grains. Then all wheels with a 6-inch diameter or over must be speed tested to a speed 50 per cent greater than the speed at which they will be operated. Because the breaking stress varies as the square of the operating speed, the wheels are subjected to a stress two and a quarter times the stress they will experience in operation. Every wheel must be inspected for size and to be sure there are no apparent defects — as chips, seams, etc. In addition there are a number of



special tests which apply to special wheels — as tests for truth, special shapes, etc.

Grinding wheels, although they are extremely hard and strong, must be carefully packed because the vitrified wheel is much like glass in that it is relatively fragile and sensitive to shock. After a number of sad experiences with cheaper packing materials, grinding wheel manufacturers have finally decided that the very best possible packing mediums must be used to protect the wheels in transit from shock.

We have outlined the manufacture of the most common of the abrasive products — the vitrified bonded grinding wheel. Some of the chief products of this kind are crankshaft wheels, 42 inches in diameter, used for making absolutely round and reasonably close to dimensions the bearings and pins of crankshafts used in automobiles; the wheels for cylindrical grinding machines used for finishing of all sorts of round bearing surfaces; honing sticks — small sticks approximately ½ x ½ x 6 inches used for putting a high finish on the inside of automobile cylinders; snagging wheels made of coarse grain used for the roughing operation of removing risers and fins from castings, and blemishes from steel billets — many of these today are made by the rubber or resinoid process; the internal wheels used for finishing the interior of holes 3 inches and less in diameter; the mammoth pulpstones 54 x 72 inches made by assembling segments, used by the paper industries for reducing the wood logs to fine pulp, etc. There are countless others, every one of which is of vital importance to our industrial life of today.

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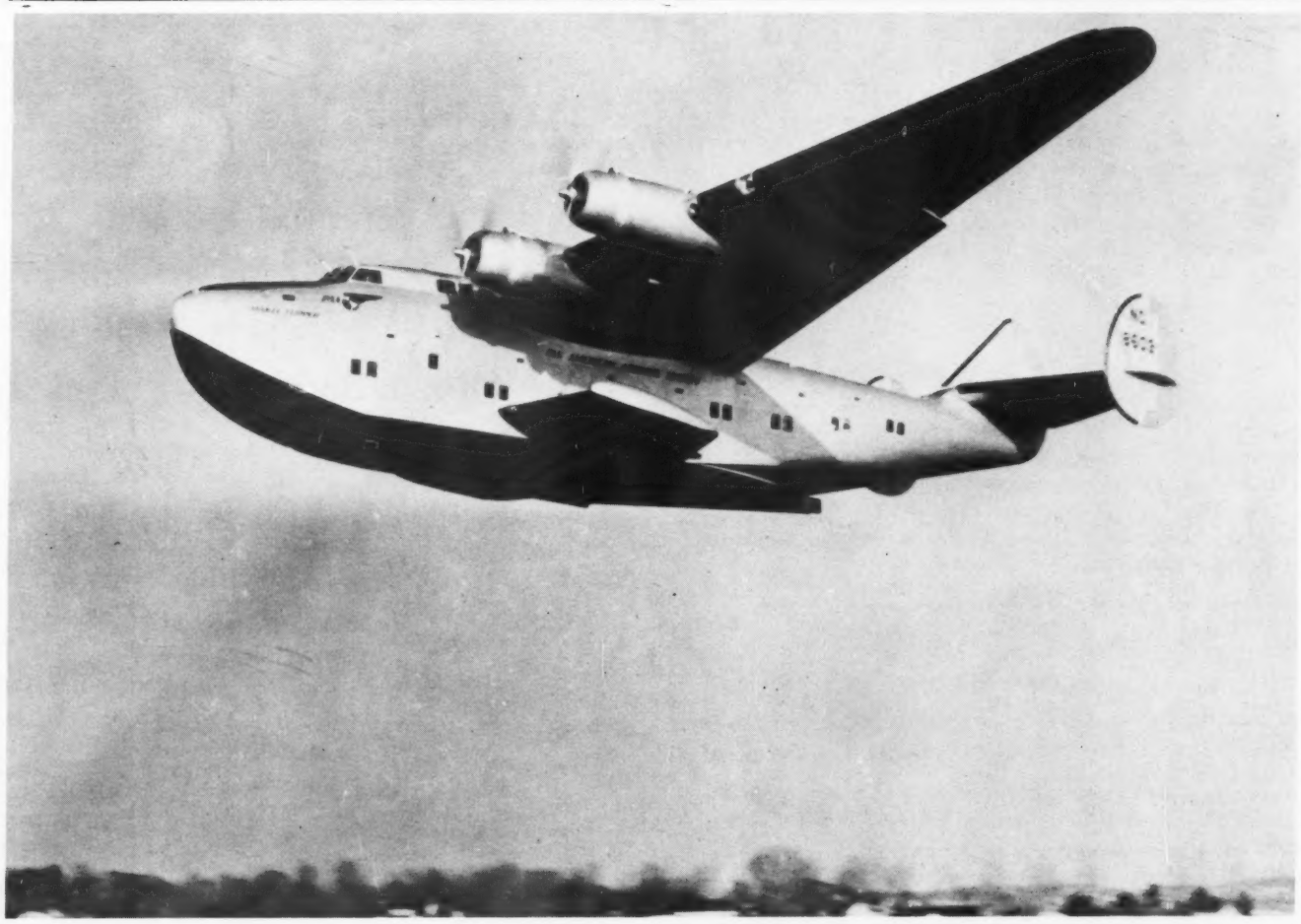

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THE DISPATCHER

(*Continued from page 138*)

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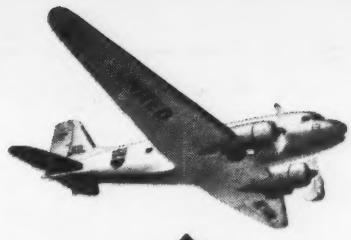
The dispatcher must know well in advance what he considers to be the margin of safety with respect to gasoline loads because once a seat is sold it cannot be secured by the dispatcher in event he changes his mind and decides more gasoline is necessary.

Such are the vital duties of the airline dispatchers of today, whose jobs are so important they comprise the very nerve centers of operations.

NO MORE STATIC

(*Continued from page 143*)

at Paxton, Mass., near Worcester, Mass. There, on Mount Asnebumskit, at 1,390 feet above sea level, the signals from Boston are received and re-transmitted on a new frequency of 43 megacycles with a power of 2 kilowatts. A special turnstile antenna mounted on a 400-foot mast gives the signal an added boost. Reception in Boston, at a distance of 40 miles, is virtually noiseless. It even surpasses some of the nearby standard



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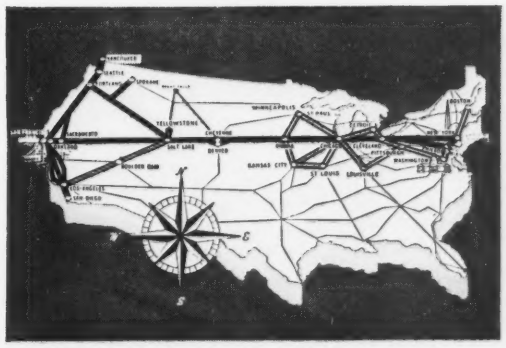

★

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Made of extra quality cotton yarn, carefully inspected, and guaranteed free from all imperfections of braid or finish.
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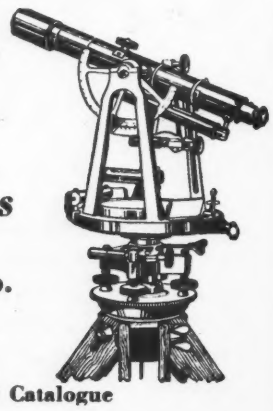

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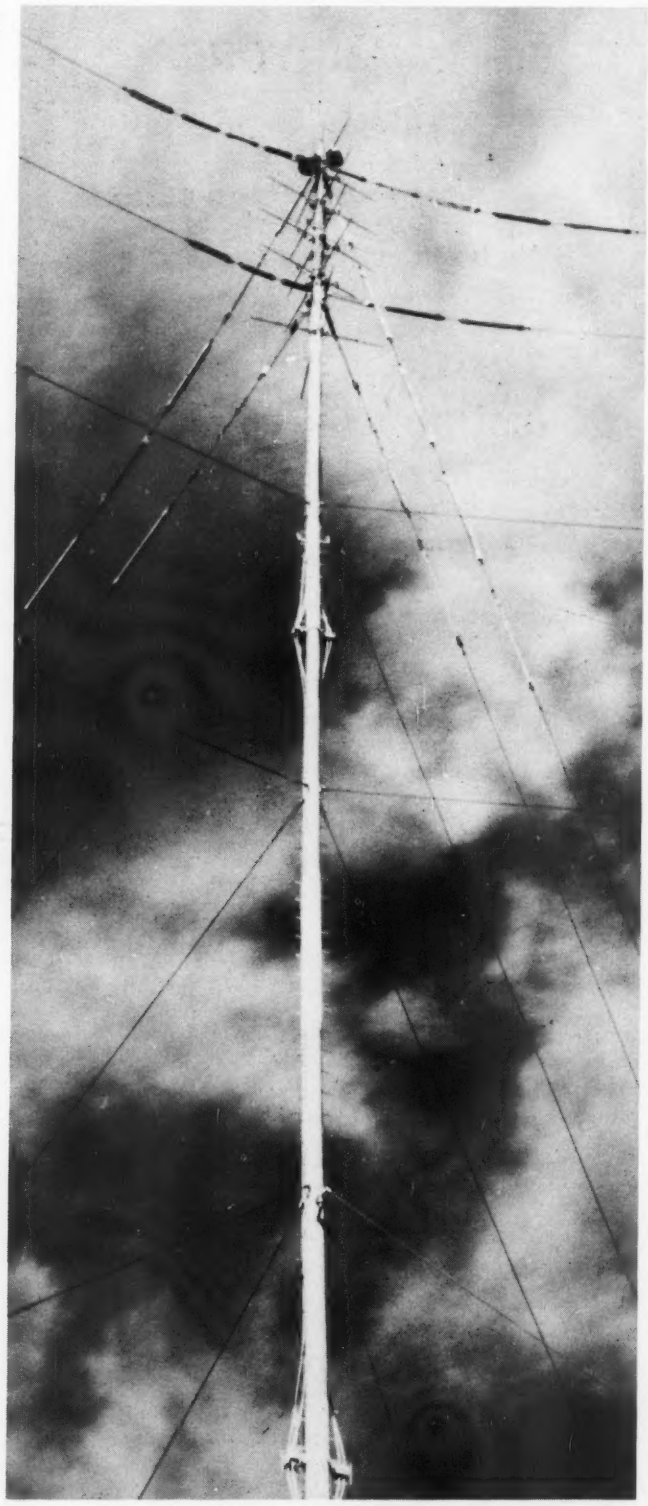
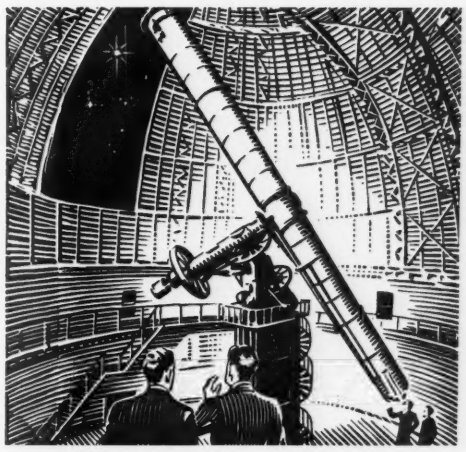
broadcast stations in Boston for over-all signal intensity. A new 50 kilowatt transmitter will soon be placed in operation at W1XOJ. The power increase is expected to provide near-perfect reception for many more listeners in New England.

Frequency modulation is revolutionary in nature to the science of radio, but whether or not it will completely replace the present system is a question which cannot be answered for the moment. The huge investments in amplitude modulation, plus the amount necessary for new receivers and transmitters, are the largest obstacles to the success of frequency modulation. If there is a change it will probably be a gradual one. To this end, receivers covering both the old and new types of broadcasting are now available. With the progress to date of the manufacture of receivers and transmitters, and the increasing interest being manifested everywhere, the trend seems to be towards frequency modulation as the form of radio for tomorrow.



RIGHT OR WRONG?

A 2-minute test for telephone users



1. Bell Telephone engineers are making exhaustive studies of solar data from observatories all over the world.

RIGHT ☐ ***WRONG*** ☐

2. Radio network programs are transmitted from studios to broadcasting stations over regular telephone circuits.

RIGHT ☐ ***WRONG*** ☐

3. Twenty years ago, putting through a long distance connection took about three times as long as it does today.

RIGHT ☐ ***WRONG*** ☐

4. Lowest telephone rates to most out-of-town points are available every night after 7 P. M. and all day Sunday.

RIGHT ☐ ***WRONG*** ☐

ANSWERS:

1. *Right.* They're learning how and why sun spots affect radio telephony, in order to give you better overseas and ship-to-shore service.

2. *Wrong.* Broadcasting stations are linked by more than 60,000 miles of *special* circuits, developed to transmit the extremely high and low frequencies of music.

3. *Wrong.* Since 1919 the average time for making a long distance connection has been cut from 10 minutes to 1.4 minutes.

4. *Right.* Why not telephone your family or distant friends oftener?

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM

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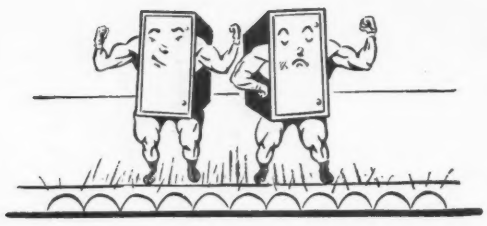
G-E Campus News

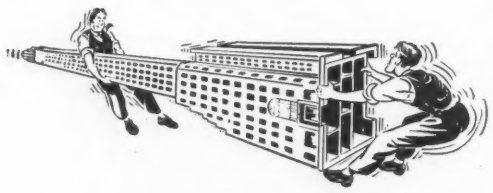


CONQUERING HEROES

TWO newcomers to the G-E family of electric products took the stage recently and proved to 250 industrial, utility, and railroad guests that they could "take it." The pair were oil-less circuit breakers, designed for applications heretofore limited to oil-type breakers.

As are all their brethren, these breakers are designed to protect electric circuits, interrupting those circuits when the current rises to a dangerous level. One of the pair operates magnetically. The other uses high-pressure air. As they should have been, the actual circuit interrupting tests in themselves were properly uneventful. The breakers passed them with ease—even though one test exceeded their interrupting ratings by 50 per cent.

Among those present were three distinguished ex-Test men—E. O. Shreve, Iowa State '04, G-E vice-president in charge of apparatus sales; M. O. Troy, Virginia '96, commercial vice-president and head of the Central Station Department; and D. C. Prince, Illinois '12, head of the engineering department, G-E Philadelphia Works.

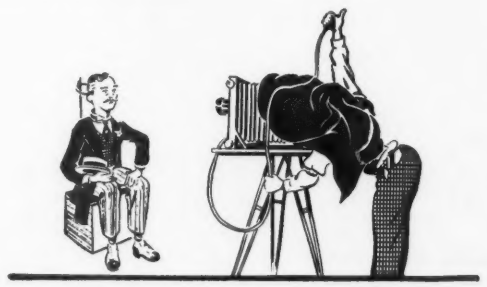


SKYSCRAPER STRETCHERS

NEW YORKERS who have the tallness of their city's skyscrapers neatly cataloged in their minds will soon have some mental reorienting to do. General Electric engineers are stretching the towering G-E building in mid-town Manhattan.

The actual stretchers are four 25,000,000-candlepower searchlights of a type recently introduced by General Electric. Each contains three "midget suns"—1000-watt water-cooled mercury lamps the size of a cigarette. Four of these searchlights are being mounted so that they will send their streaks of bluish-white light up the building's corners, accentuating the structure's vertical lines and creating an illusion of greater height. Under favorable atmospheric conditions the beam will be visible high above the tower.

Thus, G-E illuminating engineers, some of whom only recently completed the Test Course for engineering college graduates, continue to introduce new methods of illumination. Other examples of their work can be seen in all parts of the nation—on highways, buildings, city streets, athletic fields, and hundreds of other places.



SIT STILL, PLEASE!

SOME photographic subjects are the perfection of immobility, but not so the subjects of W. K. Rankin, G-E engineer. He photographs electric arcs, the flashes of electricity that occur when a circuit is broken.

Before he could photograph these arcs, Mr. Rankin had to catch up with them. He designed what is believed to be the world's fastest camera—capable of taking 120,000 pictures per second. The fast-stepping arcs occurring in various types of electric apparatus can now be more closely studied and the product itself improved.

In making the camera it was found undesirable to use glass lenses. Therefore, the pinhole principle was used, employing 1000 holes of .01 inch diameter through which light passes to the film. The camera is its own darkroom, being surrounded by a case large enough to house its operators.

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